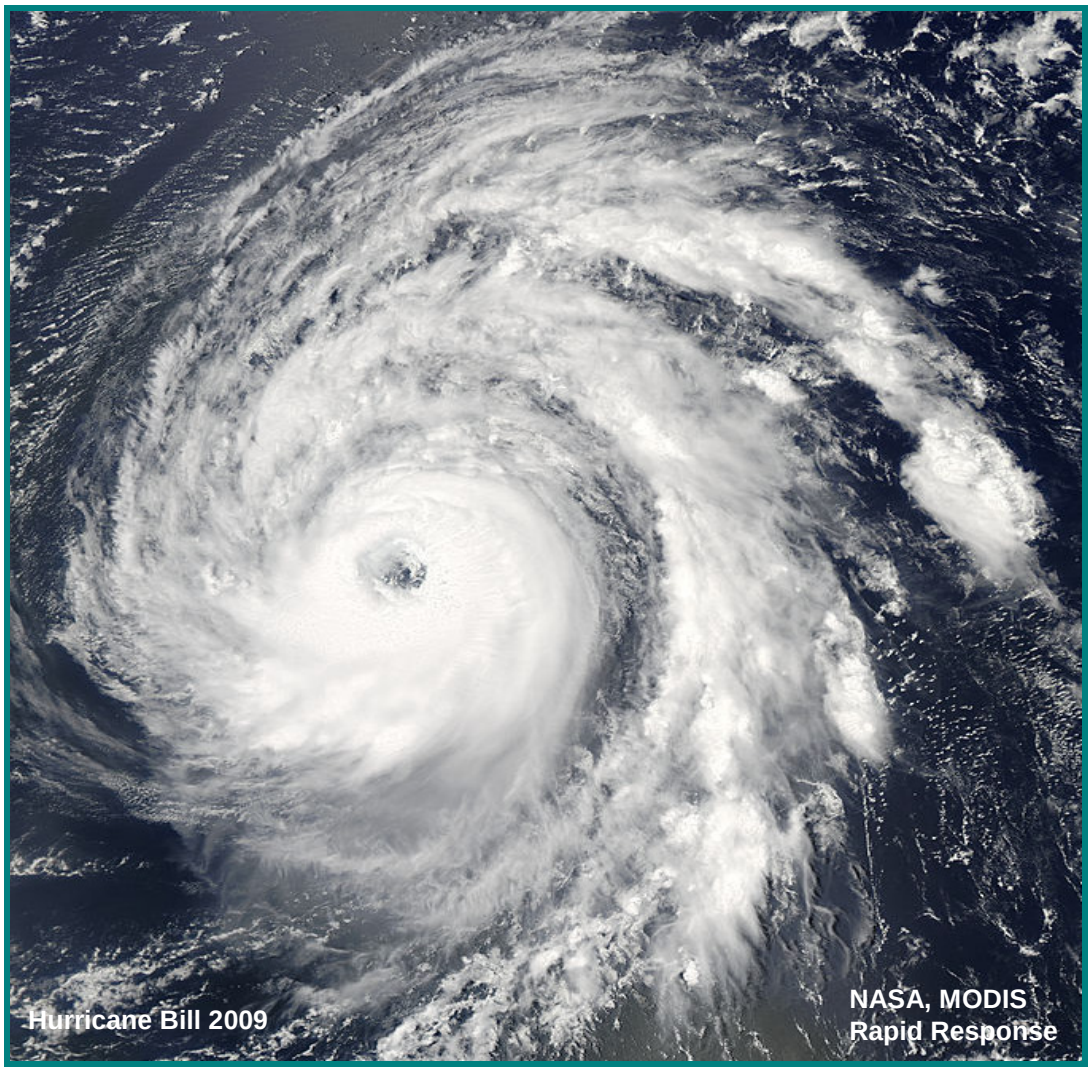
Florida Commission on Hurricane Loss Projection Methodology



Professional Team Report
2009 Standards

Risk Management Solutions, Inc.

On-Site Review
March 28-31, 2011

On March 28-31, 2011, the Professional Team visited on-site at Risk Management Solutions, Inc. (RMS) in Newark, California to review RiskLink version 11.0. The following individuals participated in the review:

RMS
Munish Arora, M.S., Manager Model Management
Hesaam Aslani, Ph.D., Manager Catastrophe Risk Modeler Product Development
Enrica Bellone, Ph.D., Principal Modeler
Auguste Boissonnade, Ph.D., Vice President, Probabilistic Modeling
Han Chen, Ph.D., Principal Software Engineer
Kay Cleary, FCAS, MAAA, FCA, Actuary & Director, Mitigation & Regulatory Affairs
Vincent Daniel, Ph.D., Senior Project Director Model Development
Michael Drayton, Ph.D., Consultant
Sridhar Iyer, Manager, Financial Modeler
Steve Jewson, DPhil, Vice President Model Development
Pratiksha Kadam, Software Engineer
Swaminathan Krishnamoorthy, Manager, Model Development
Charles Menun, Ph.D., P.E., Consultant
Guy C. Morrow, S.E., Senior Vice President Model Development
Matthew J. Nielsen, Senior Product Marketing Manager
Ilesh Patel, Technical Services Engineer IT Operations
Mohsen Rahnama, Ph.D., Senior Vice President Model Development
Ambica Rajagopal, Ph.D., Lead Financial Modeler
Clare Salustro, Senior Analyst Natural Catastrophe & Portfolio Solutions
Pooya Sarabandi, Ph.D., P.E., Director Model Development
Guido Schroeder, Ph.D., Lead Catastrophe Risk Modeler Model Development
Ali Shahkarami, Ph.D., Lead Catastrophe Risk Modeler Model Development
Bronislava Sigal, Ph.D., Lead Financial Modeler
Rajesh K. Singh, Ph.D., P.E., Senior Director, QA Engineering
Ajay Singhal, Ph.D., Vice President Model Development
Beth Stamann, Senior Documentation Specialist, Mitigation and Regulatory Affairs
Joel Taylor, Senior Analyst, Mitigation & Regulatory Affairs
Pantea Vaziri, Ph.D., Catastrophe Risk Modeler, Mitigation & Regulatory Affairs
Michael Young, M.E.Sc., P.E., Senior Director Mitigation & Regulatory Affairs

Professional Team
Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Masoud Zadeh, Ph.D., P.E., Structural Engineer
Donna Sirmons, Staff

The review began with introductions and an overview of the audit process.

On March 14, 2011, RMS notified the Commission of "material errors or revisions to the RMS North Atlantic Hurricane Model, RiskLink 11.0 Submission." RMS stated they "identified three issues that cause loss results to change slightly from originally submitted values." The following

revised forms and appendix were submitted along with an explanation of the issues and the corrections to the software platform and data files.

- Expert Certification Forms G-1 (General Standards), G-4 (Actuarial Standards), G-5 (Statistical Standards), and G-7 (Editorial)
- Form A-7 (Percentage Change in Personal Residential Output Ranges)
- Form A-9 (Probable Maximum Loss for Florida)
- Form S-2 (Examples of Loss Exceedance Estimates)
- Appendix C

The audit opened with an explanation by RMS of the issues and corrective actions taken. Two additional issues identified since the March 14, 2011, notification were reported and explained. 1) Field indicating the default vulnerability curve selection set was omitted from the Analysis Summary Report for FCHLPM. Revised Appendix C and Appendix D were provided. 2) The impact of the geocoding update provided in January with the response to the deficiencies was incorrect. Discussed how it was discovered that the percentage change was reported incorrectly.

RMS provided a table of editorial changes and revised pages made since the initial submission.

RMS then followed with a presentation of a module component recap with the changes in RiskLink version 11.0 and the impact of those changes on loss costs.

- New stochastic event set based on updated data related to the 2009 version of HURDAT
- New probability distributions for translational speed, storm heading, storm intensity, frequency and Rmax
- New analytical wind profile
- Updated roughness and gust coefficients
- New sources of information for historical wind observations
- Updated residential and commercial-residential vulnerability curves
- New coastal and inland vulnerability regions
- Revised square footage bands for single family residential risks
- Additional occupancy categories for commercial residential
- Reorganization of secondary modifier options
- Updated post event loss amplification model (Demand Surge)
- Updated ZIP Code database

RMS identified the inland filling update and the new vulnerability zones and curves as the two key updates in the model. Counties that are coastal generally had a decrease in loss costs while inland counties had an increase.

The Professional Team reviewed the following corrections to be included in the revised submission which is to be provided to the Commission no later than 10 days prior to the meetings for reviewing models for acceptability:

- Page 5, Model Submission Checklist – model name corrected
- Page 9, Model Identification – corrected model version to include service pack number
- Page 25, G-1.2 – corrected the relationship between Vmax and central pressure
- Page 38, G-1.5.a – under Vulnerability Module added additional claims data
- Page 39, G-1.5.c – corrected geocoding change in Table 1, Figures 4 and 5 corrected, text added on vulnerability changes
- Page 49, G-2.2.a – corrected tenure in Table 6 for Swaminathan Krishnamoorthy

- Page 63, G-2.2.a – updated title and bio sketch for Swaminathan Krishnamoorthy
- Page 103, Form G-6 – revised to include new signatory, Swaminathan Krishnamoorthy
- Page 110, M-2.3 – changed special to spatial
- Page 120, M-4.3 – Table 10 updated for consistency in model parameter names
- Pages 143-148, Form M-2 – legends in maps revised
- Page 157, V-1.2 – description of loss data added
- Page 163, V-1.x – added details on loss data
- Page 162, V-2.1 – text added on toe nailing
- Page 172, Form V-2 – updated Figure 43
- Page 181, A-5.2 – corrected Appendix reference to D
- Page 372, Form S-6 – CF defined as conversion factor
- Page 389, C-6.2 – corrected model revision numbering system
- Page 404, Appendix C – updated screenshot to include service pack number with the model version number
- Page 405, Appendix D – updated Analysis Summary Report for FCHLPM and Post Import Summary to include service pack number with the model version number
- "et al." formatted for consistency throughout the submission document (Pages 23, 24, 26, 107-109, 114, 117, 118, 120, 128, 132, 134, 159, and 361)

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the December 14, 2010 meeting. The deficiencies were corrected by the established time frame and the corrections have been verified.

1. Standard G-1, Disclosure 5.B & C (page 39)
    a. Percentage difference in the average annual zero deductible statewide loss costs not provided separately for the stochastic module and the wind field module.
    b. Color-coded map by county reflecting the percentage difference in average annual zero deductible statewide loss costs not provided separately for the stochastic module and the wind field module.
    c. Percentage difference in the average annual zero deductible statewide loss costs not provided for the geocoding module.
    d. Color-coded map by county reflecting the percentage difference in average annual zero deductible statewide loss costs not provided for the geocoding module.

2. Standard G-1, Disclosure 4 (page 30)
    Willoughby (2006) reference not provided in the reference list

3. Standard V-1, Disclosure 3 (page 159)
    Summary description of site inspections not provided

4. Form S-6 (page 372)
    a. Form S-6 not included in the submission document.
    b. Files sent for the Uncertainty Analysis do not correspond to the results given in Table 2 on page 5 of the Form S-6 pdf description file submitted. The variances of

loss costs with the other factors held constant are 15-25% of the overall variance of loss costs across the five factors and for the three categories of storms.

Professional Team Pre-Visit Letter

The Professional Team's pre-visit letter questions are provided in the report under the corresponding standards.

Pre-Visit Letter

The purpose of the pre-visit letter is to outline specific issues unique to the modeler's submission, and to identify lines of inquiry to be followed during the on-site review so as to allow adequate preparation by the modeler. Aside from due diligence with respect to the full submission, various questions that the Professional Team is certain to ask the modeler during the on-site review are provided in this letter. This letter does not preclude the Professional Team from asking for additional information during the on-site review that is not given below or discussed during an upcoming conference call that will be held, if requested by the modeler. One goal of the potential conference call is to clarify points in this letter. The comments are grouped by standards sections. The overall intent is to expedite the on-site review and to avoid last minute preparations that could just as easily have been handled earlier.

Some of this material may have been shown or may have been available on a previous visit by the Professional Team. The Professional Team will also be considering material in response to deficiencies and issues designated by the Florida Commission on Hurricane Loss Projection Methodology (Commission).

The goal of the Professional Team on-site review is to provide the Commission with a clear and thorough report of the model, subject to non-disclosure restrictions on proprietary information. All modifications, adjustments, assumptions, or other criteria that were included in producing the information requested by the Commission in the submission should be disclosed and will be reviewed.

It is important that all material prepared for presentation during the on-site review be presented using a medium that is readable by all members of the Professional Team simultaneously. The Professional Team will review selected computer code in conjunction with the reviews performed for each section. Computer code should be available in a format that will allow simultaneous visualization by the entire Professional Team. Access to critical articles or materials referenced in the submission or during the on-site review should be available on-site for the Professional Team. The Professional Team should be provided access to an internet connection through one of the Professional Team member computers for reference work that may be required while on-site.

The presentation during the on-site review is recommended to proceed in the following sequence: (1) new, or updated, material related to the model; (2) responses to the pre-visit letter questions and issues; and (3) responses to the audit items for each standard in the Report of Activities.

Be prepared to provide for the Professional Team's review, all insurance company claims data received since 2004, including all data related to the 2004 and 2005 hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2007 FHCF exposure data.

When the Professional Team arrives on-site, provide five (5) printed copies of all figures with scales for the *X* and *Y* axes labeled that are not so labeled in the submission. Label the figures with the same figure number as given in the submission. Also provide five (5) printed copies of Form V-3 and the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete.

Be prepared to provide for the Professional Team's review all engineering data (post event surveys, tests, etc.) received since the review by the Professional Team in 2006. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

If any changes have been made in any part of the model or the modeling process from the descriptions provided in the original 2010 submission, provide the Professional Team with a complete and detailed description of those changes, the reasons for the changes (e.g., an error was discovered), and all revised Forms where any output of the Form changed.

For your information, the Professional Team will arrive in business casual attire.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation*

*(*Significant Revision)*

The computer model shall project loss costs and probable maximum loss levels for residential property insured damage from hurricane events.

Audit

1. The main intent of the audit is to determine the capabilities of the model and to assess its implementation for purposes of Florida projected insured loss costs and probable maximum loss levels. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.

2. All software located within the model, used to compile data used by the model, used to validate the model, and used to project model loss costs and probable maximum loss levels (1) fall within the scope of the Computer Standards, and (2) will be reviewed interactively (viewed simultaneously by all Professional Team members in conjunction with the review of each standard).

3. Maps, databases, or data files relevant to the modeling organization's submission will be reviewed.

Pre-Visit Letter

1. G-1, Disclosure 2, pages 23-27: The Professional Team will need to see a more elaborate description of the new stochastic module and the new windfield (or wind hazard) module. In particular, the following points should be covered.
    a. Provide a description of landfall correlation.
    b. Provide a definition of pressure difference as used.
    c. Provide an explanation of dependency of central pressure difference on translational speed.
    d. Provide the formulation of dependency of maximum wind on central pressure difference.
    e. Identify the windfield parameters referred to on page 25.
    f. Provide a detailed description of windfield parameter Rmax dependence on central pressure and whether the four parameters to reduce variance are computed once globally or are dependent on other parameters.
    g. Provide a description of how uncertainty in maximum peak gust at Variable Resolution Grid are accounted for.

2. G-1, Disclosure 2, pages 27-29: Similarly, the Professional Team would like to see a more elaborate description of the vulnerability or damage assessment module. In particular, the following points should be covered.
    a. Provide a description of how uncertainty in damage ratios are modeled.
    b. Provide how Component Vulnerability Model based vulnerability models are calibrated by historical data and also bounded by the Component Vulnerability Model.
    c. Provide an explanation of "average" vulnerability and how it might relate to unknown class.

3. G-1, Disclosure 2, page 29: Provide an explanation of how the upper limits are set for beta distributions used for additional living expense/business interruption coverage.

4. G-1, Disclosure 5.B, page 39: Be prepared to explain spatial distributions of changes reflected by changes in the stochastic module and the windfield module.

5. G-1, Disclosure 5.C, page 41: Explain the resulting large vulnerability changes (minimum 20% increase) for most of the counties within the realm of Martin, Collier, Citrus, Clay, and Flagler Counties, for example, in Figure 5.

6. G-1, Disclosure 5.C, page 42: Explain the resulting financial model changes for Osceola, Orange, and Seminole Counties in Figure 6, and why these are the same counties with highest changes in results due to vulnerability changes.

7. G-1, Disclosure 5.C, page 43: Explain the all changes combined result for Jackson County in Figure 7 as well as the large increases for counties in central Florida.

Verified: YES

Professional Team Comments:

Reviewed maps with the spatial distribution of loss costs throughout the state for the previously accepted model version and the current model version. Discussed the magnitude of loss cost changes for Palm Beach, Orange, and Santa Rosa counties.

Reviewed comparison of modeled results for Hurricanes Charley (2004), Ivan (2004), Jeanne (2004), Frances (2004), Wilma (2005), Katrina (2005), and Dennis (2005) with loss estimates from the Florida Office of Insurance Regulation and Property Claims Services.

Reviewed comparison of modeled and actual losses for residential portfolios for Florida landfalling hurricanes.

Discussed RMS' submission of their general model rather than a Florida-only version (as in the past).

Reviewed updated version of Table 1 of statewide changes by model component.

Reviewed the criteria used to measure the dependencies among multiple landfalls from single storms in different areas.

Discussed the definition of central pressure difference as used in the model.

Discussed the dependency of central pressure difference on translational speed. Reviewed histogram of central pressure and translation speed.

Reviewed the relationship between Vmax and central pressure.

Reviewed the windfield parameters. Reviewed windfield validation maps with H*Wind data. Reviewed contour plot of windfield asymmetry and translational speed.

Reviewed Rmax formulation and underlying data. Reviewed plot of Hurricane Rita (2005) Rmax and central pressure.

Reviewed the uncertainty in the maximum peak gust, the mean of the distribution, and the basis for the coefficient of variation of the distribution.

Reviewed the component vulnerability model and the methodology for combining the components to create the vulnerability functions and how they are calibrated by historical data.

Reviewed the base vulnerability functions which represent the average vulnerability and are the default for unknown.

Reviewed the beta distribution calculations. Discussed the upper limit setting.

Reviewed the vulnerability changes in Martin, Collier, Citrus, Clay, Orange, and Flagler Counties. Reviewed comparison of vulnerability curves between the previously accepted model version and the current model version.

Discussed the changes in Post Event Loss Amplification (demand surge) affecting the loss costs in Osceola, Orange, and Seminole Counties and the increases when combined with the vulnerability changes.

Reviewed the overall increases in Jackson County due to the vulnerability changes and the inland filling model showing increased winds.

Reviewed the overall changes in Gadsden and Calhoun Counties.

Reviewed major model changes and their incremental impact on loss costs.

G-2 Qualifications of Modeling Organization Personnel and Consultants

A. Model construction, testing, and evaluation shall be performed by modeling organization personnel or consultants who possess the necessary skills, formal education, and experience to develop the relevant components for hurricane loss projection methodologies.

B. The model or any modifications to an accepted model shall be reviewed by either modeling organization personnel or consultants in the following professional disciplines: structural/wind engineering (licensed Professional Engineer), statistics (advanced degree), actuarial science (Associate or Fellow of Casualty Actuarial Society), meteorology (advanced degree), and computer/information science (advanced degree). These individuals shall be signatories on Forms G-1 through G-6 as applicable and shall abide by the standards of professional conduct if adopted by their profession.

Audit

1. The professional vitae of modeling organization personnel and consultants responsible for the current model and information on their predecessors if different than current personnel will be reviewed. Background information on individuals providing testimonial letters in the submission shall be provided.

2. Forms G-1, G-2, G-3, G-4, G-5, G-6, and all independent peer reviews of the model under consideration will be reviewed. Signatories on the individual Forms will be required to provide a description of their review process.

3. Discuss any incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

Pre-Visit Letter

8. G-2, Disclosure 2.B, page 83: Provide the resumes of new personnel in Table 7 working on the model or acceptability process who were not involved at the time of the previous Professional Team review. Discuss departures of personnel involved in the previous version of the model.

Verified: YES

Professional Team Comments:

Discussed personnel changes since the previous submission.

Reviewed resumes of new personnel. Most additions are due to submission of the general model rather than a Florida only version.

- Hesaam Aslani, Ph.D. Structural Engineering and its application in Catastrophe Modeling, Stanford University, Stanford, CA; M.Sc. Structural Mechanics, University of Tehran, Tehran, Iran; B.Sc. Civil Engineering, University of Tehran, Tehran, Iran
- Ramani Balijepalli, M.S. Computer Applications, Andhra University, India
- James C. Bull, M.S. Computer Science, Washington University, St. Louis, MO; B.S. Mechanical Engineering, Washington University, St. Louis, MO
- Stan Buyanov, Ph.D. Technical Science, Academy of Science, Moscow; M.S. Electrical Engineering, Moscow Power, Engineering University, Moscow
- Jordan Spencer Byk, MBA, Rutgers University, NJ; M.S. Carnegie-Mellon University
- Christopher Keir Campbell, B.A. Geography, University of Texas, San Antonio, TX
- Monisha Chahal, B.A. MSRIT, Bangalore, Diploma in Software Development, IBM, Delhi, India
- Steven Chau, B.B.A. MIS with minor in Computer Science, The University of Iowa, Iowa City, IA
- Albert Ming-Wei Chen, M.S. Structural Engineering, Stanford University, Stanford, CA; B.S. Civil Engineering, National Taiwan University, Taipei, Taiwan
- Tommy S. Chou, Software Quality Assurance Certificate, Software Advanced Technologies Institute (SATI), San Francisco, CA; B.A. Development Studies of Industrialized Societies, University of California at Berkeley, Berkeley, CA
- Vincent Daniel, Ph.D. Atmospheric Science, Laboratoire de Meteorologie Dynamique, Paris, France; M.Sc. Physics and Applied Mathematics, Ecole Normale Superieure, France
- Ravisher S. Dhillon, M.S. Software Engineering, San Jose State University, San Jose, CA; B.Tech. Computer Science & Engineering, Punjab Technical University, India
- Anjali Garg, M.S. Computer Application, Institute of Management Studies, Ghaziabad, India
- Olga Goldin, Certificate in Software Quality Assurance, WindTest Instruments, Los Altos, CA; B.S. Economics and Finance, State University, Baku, Russia
- Timothy M. Hall, Ph.D. Physics, Cornell University, Ithaca, NY; B.A. Physics, Wesleyan University, Middletown, CT
- Atin Kumar Jain, M.S. Awadhesh Pratap Singh University, India; Post Graduate Diploma Advanced Computing by C-DAC, India
- Nancy Johns, B.A. Applied Mathematics, California State University, Fullerton, CA; A.A. Mathematics, Golden West Community College, Huntington Beach, CA
- Jeffrey Kilbreth, MBA Yale University, New Haven, CT; B.A. Yale College, New Haven, CT
- Joseph Kim, M.S. Computer Science, University of Southern California, Los Angeles, CA; B.S. University of California, Irvine, CA
- Veena Krishnamoorthy, M.S. Physics, Madras University, India
- Greer Kingston, Ph.D., The University of Adelaide, South Australia; B.S. Civil & Environmental Engineering, The University of Adelaide South Australia
- Tanmay Kumar, M.S. Computer Applications, MNREC, Allahabad, India; B.S. KU, Nainital, India

- Nereida Lark, M.S. Computer Information Systems, University of Phoenix, Phoenix, AZ; B.S. Computer Science, Park University, Parkville, MO
- Li Liang
- Chiao-Ju Sonja Liu, M.S. Computer Engineering, Santa Clara University, Santa Clara, CA; B.S. Math and Computer Science, San Jose State university, San Jose, CA
- Dag Lohmann, Ph.D., GKSS Research Center, Geesthacht, Germany; Physics, Georg-August-University, Goettingen, Germany; Felix-Klein-Gymnasium, Goettingen, Germany; Max-Planck-Gymnasium, Goettingen, Germany; Hoeltyschule, Goettingen, Germany
- James A. Lord, M.S. Computer-Aided Civil Engineering, Carnegie Mellon University; B.S. Civil Engineering, University of California at Berkeley, Berkeley, CA
- Bruce M. Miller, B.S. Engineering Physics, University of Colorado, Boulder, CO
- Nayna Mistry, M.S. Computer Science, California State University, Hayward, CA; B.S. Civil Engineering, Gujarat University, India
- Hans Nelsen, B.A. Philosophy, Creighton University
- Geoffrey R. Overton, M.A. Geography, University of Nebraska, Omaha, NE; B.G.S. Geography, University of Nebraska, Omaha, NE; A.O.S. Culinary Arts, Western Culinary Institute, Portland OR
- Rupesh N. Parikh, B.S. Chemical Engineering, University of California, San Diego, CA
- Chris Juliana Peter Perianayagam, M.S. Information Technology and Management, Illinois Institute of Technology, Chicago, IL; B.Tech. Information Technology, Sathyabama Institute of Science and Technology, Chennai, India; B.E. Electronics and Communication Engineering, Sathyabama Institute of Science and Technology, Chennai, India
- Sudha Raghavan, M.C.A. Mother Teresa Women's University, India; B.S. Mathematics, University of Madras, India
- Ambica Rajagopal, Ph.D. Mathematics, Purdue University, West Lafayette, IN; M.S. Mathematics with Computational Finance Specialization, Purdue University, West Lafayette, IN; M.Sc. Mathematics, BITS Pilani, India
- Edida Rajesh, M.Sc. Geophysics, Andhra University, Vizag, Andhra Pradesh, India; B.Sc. Electronics, Andhra University, Vizag, Andhra Pradesh, India
- Subba Ravilisetty, M.S. Computer and Information Sciences, University of South Alabama, Mobile, AL; B.S. Electrical Engineering, Osmania University, Hyderabad, India
- Agustin Rodriguez, M.S. Structural Engineering, University of California at Berkeley, Berkeley, CA; B.S. Civil Engineering, Stanford University, Stanford, CA
- Majid Sameni, M.S. Systems Software Engineering, University of Waterloo, Waterloo, Ontario, Canada; B.S. Mechanical Engineering, University of Ferdowsi, Mashad, Khorasan
- Christopher R. Sams, B.A. Geography, University of Kansas School of Liberal Arts and Sciences, Lawrence, KS
- Pooya Sarabandi, Ph.D. Structural Engineering, Stanford University, Stanford, CA; M.S. Electrical Engineering, Stanford University, Stanford, CA; M.S. Earthquake Engineering, University of Tehran, Tehran, Iran; B.S. Civil and Environmental Engineering, University of Tehran, Tehran, Iran

- Pooja Sayal, M.B.A. Finance, Symbiosis, Pune, India; B.E. Civil, Delhi College of Engineering, New Delhi, India
- Emilie Scherer, Ph.D. Physical Oceanography and Meteorology, Université Pierre et Marie Curie, Paris, France; D.E.A. Oceanography, Meteorology and Environmental Sciences, Université Pierre et Marie Curie, Paris, France; D.E.U.G. Mathematics and Physics, Licence and Maîtrise in fundamental physics, Université de Nice Sophia-Antipolis, Nice, France
- Guido Schroeder, Ph.D. University of Hamburg, Germany; M.Sc. Meteorology with minors in Applied Mathematics and Theoretical Physics, University of Hamburg, Germany
- Debjani Sen, M.S. Liberal Arts, Southern Methodist University, Dallas, TX; Certificate in Technical Writing, San Jose State University, San Jose, CA; B.A. English, University of Calcutta, India
- Kameron T. Seto, M.S. Management Science and Engineering, Stanford University, Stanford, CA; B.A. Applied Mathematics, University of California, Berkeley, CA
- Neha B. Shah, B.S. Applied Mathematics, University of California, Los Angeles, CA
- Ali Shahkarami, Ph.D. Structural Engineering, The University of British Columbia, Vancouver, Canada; M.A.Sc. Structural Engineering, The University of British Columbia, Vancouver, Canada; B.S. Civil Engineering, Sharif University of Technology, Tehran, Iran
- Nilesh Shome, Ph.D. Structural Engineering, Stanford University, Stanford, CA; University of Arizona, Tucson, AZ
- Bronislava Sigal, Ph.D. Statistics, Stanford University, Stanford, CA; M.S. Statistics, Stanford University, Stanford, CA; B.S. Mathematics, Kiev State University, Ukraine
- Ajay Singhal, Ph.D. Civil Engineering, Stanford University, Stanford, CA; M.S. Civil Engineering, Rice University, Houston, TX; B.Tech. Civil Engineering, Indian Institute of Technology, Madras, India
- Philippe Stephan, M.S. Business and Computer Science, French 'Ecole Nationale Superieure des Mines'
- Cody M. Stumpo, M.S. Engineering, Purdue University, West Lafayette, IN; B.A. Applied Mathematics and Architecture, University of California at Berkeley, Berkeley, CA
- Taronne H.P. Tabucchi, M.S. Civil & Environmental Engineering, Civil Infrastructure Systems, Cornell University, Ithaca, NY; B.S. Engineering Science, Smith College, Northampton, MA
- Avinash Takale, M.S. Computer Application, Shivaji University, Maharashtra, India; B.S. Mathematics, Shivaji University, Maharashtra, India
- Kevin Z. Tang, M.S. Computer Science, Bowling Green State University, Bowling Green, OH; B.S. Electrical Engineering, Northwestern Polytechnic University, Xi'an, China
- Yogesh Vani, M.S. Telecommunications Systems, California State University, Hayward, CA
- Mimi Von Kugelgen, B.A. Genetics, University of California at Berkeley, Berkeley, CA
- Kenneth Wat, B.S. Computer Science, University of California, Riverside, CA

- Elizabeth Xu, Ph.D. Atmospheric Science, University of Nevada, Reno, NV; M.S. Computer Science, University of Nevada, Reno, NV; M.S. Environmental Science, Peking University, Beijing, China; B.S. Space Physics, Peking University, Beijing, China

G-3 Risk Location

A. ZIP Codes used in the model shall not differ from the United States Postal Service publication date by more than 24 months at the date of submission of the model. ZIP Code information shall originate from the United States Postal Service.

B. ZIP Code centroids, when used in the model, shall be based on population data.

C. ZIP Code information purchased by the modeling organization shall be verified by the modeling organization for accuracy and appropriateness.

Audit

1. Provide geographic displays for all ZIP Codes.

2. Provide geographic comparisons of previous to current locations of ZIP Code centroids.

3. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.

4. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.

Pre-Visit Letter

9. G-3, page 89: Be prepared to review the updated ZIP Code centroids as has been done during previous on-site reviews.

Verified: YES

Professional Team Comments:

Reviewed specific examples of ZIP Code boundary and centroid changes in DeSoto and Sumter Counties. Reviewed new versus old centroids throughout Florida.

Reviewed summary statistics of ZIP Code changes from the previous submission.

Reviewed ZIP Codes with area difference greater than 15%.

G-4 Independence of Model Components

The meteorological, vulnerability, and actuarial components of the model shall each be theoretically sound without compensation for potential bias from the other two components.

Audit

1. Demonstrate that the model components adequately portray hurricane phenomena and effects (damage, loss costs, and probable maximum loss levels). Attention will be paid to an assessment of (1) the theoretical soundness of each component and (2) the basis of their integration. For example, a model would not meet this Standard if an artificial calibration adjustment had been made to improve the match of historical and model results for a specific hurricane.

2. Describe all changes in the model since the previous submission that might impact the independence of the model components.

Verified: YES

Professional Team Comments:

There was no evidence to suggest that one component of the model was artificially adjusted to compensate for another component.

G-5 Editorial Compliance

The submission and any revisions provided to the Commission throughout the review process shall be reviewed and edited by a person or persons with experience in reviewing technical documents who shall certify on Form G-7 that the submission has been personally reviewed.

Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of November 1, 2009*.

2. Describe all changes to the submission document since the previously accepted submission that might impact the final document submission.

3. Demonstrate that the submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and inclusion of extraneous data or materials.

4. Demonstrate that the submission has been reviewed by the signatories on Forms G-1 through G-6 for accuracy and completeness.

5. The modification history for submission documentation will be reviewed.

6. A flowchart defining the process for form creation will be reviewed.

7. Form G-7 will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the submission review process for accuracy and completeness.

Editorial items noted by the Professional Team during the on-site review were satisfactorily addressed during the audit. The Professional Team has reviewed the submission per Audit item 3, but cannot guarantee that all editorial difficulties were identified. The modeler is responsible for eliminating such errors.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT starting at 1900 as of June 7, 2009 (or later). Complete additional season increments based on updates to HURDAT approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

B. Any trends, weighting, or partitioning shall be justified and consistent with currently accepted scientific literature and statistical techniques. Calibration and validation shall encompass the complete Base Hurricane Storm Set as well as any partitions.

Audit

1. The modeling organization's Base Hurricane Storm Set will be reviewed.

2. Provide a flowchart illustrating how changes in the HURDAT database are used in the calculation of landfall distribution.

3. Reasoning and justification underlying any modification by the modeling organization to the Base Hurricane Storm Set will be reviewed.

4. Reasoning and justification underlying any short-term and long-term variations in annual hurricane frequencies incorporated in the model will be reviewed. (Trade Secret List item)

5. Modeled probabilities will be compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical hurricane frequencies for the four regions of Florida and overall as provided in Form M-1 will be reviewed.

6. Form M-1 will be reviewed for consistency with Form S-1. Changes to the modeling organization's Base Hurricane Storm Set from the previously accepted submission will be reviewed.

7. Comparisons of modeled probabilities and characteristics from the complete historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against the complete historical record. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete historical record.

Pre-Visit Letter

10. M-1, page 107: Clarify the relationship of the “official HURDAT track set” to the Base Hurricane Storm Set.

Verified: YES

Professional Team Comments:

Reviewed changes to the Base Hurricane Storm set consistent with the HURDAT reanalysis through 1925 for the updated historical time period 1900-2008.

Reviewed flow chart documenting how changes in the HURDAT database are used in the calculation of landfall distribution.

Discussed no partitioning or modifications to the Base Hurricane Storm set.

Clarified that the “official HURDAT track set” is compiled from the HURDAT database for landfalling and bypassing storms.

Form M-1 was reviewed for consistency with Form S-1.

M-2 Hurricane Parameters and Characteristics*

*(*Significant Revision)*

Methods for depicting all modeled hurricane parameters and characteristics, including but not limited to windspeed, radial distributions of wind and pressure, minimum central pressure, radius of maximum winds, strike probabilities, tracks, spatial and time variant windfields, and conversion factors, shall be based on information documented in currently accepted scientific literature.

Audit

1. All hurricane parameters used in the model will be reviewed.

2. Prepare graphical depictions of hurricane parameters as used in the model. Describe and justify:

   - The data set basis for the fitted distributions,
   - The modeled dependencies among correlated parameters in the windfield component and how they are represented,
   - The asymmetric nature of hurricanes,
   - The fitting methods used and any smoothing techniques employed.

3. The treatment of the inherent uncertainty in the conversion factor used to convert the modeled vortex winds to surface winds will be reviewed and compared with currently accepted scientific literature. Treatment of conversion factor uncertainty at a fixed time and location within the windfield for a given hurricane intensity will be reviewed.

4. All cited scientific literature provided in Standard G-1 will be reviewed to determine applicability.

5. All external data sources that affect model generated windfields will be identified and their appropriateness will be reviewed.

6. Describe the value(s) of the far-field pressure used in the model and approximate its sensitivity on the average annual zero deductible statewide loss costs.

Pre-Visit Letter

11. M-2, page 108: Provide a reference for the over water intensity model.

12. M-2, Disclosure 1, page 108: Identify the wind profile parameters.

13. M-2, Disclosure 3, page 109: Provide the definition of intensity used to classify landfalling and by-passing hurricanes.

14. M-2, Disclosure 3, page 109: Provide functional dependencies (if appropriate) and any other details on inland filling rate, radius of maximum winds, and wind profile models.

15. M-2, Disclosure 3, page 110: Provide details on modeling far field pressure and its dependence on “special position and time of the year.”

16. M-2, Disclosure 6, page 110: Provide details on the local roughness and gust coefficients.

17. M-2, Disclosure 6, page 110: Provide the range of magnitudes for gust factors spanning all land use classes in the model.

18. M-2, Disclosure 7, page 111: Describe the method of selection for historical storm tracks “taken from the HURDAT database.”

19. M-2, Disclosure 9, pages 111-113: Describe relationship of landfall counts given on Figurers 10 and 11 to those given on Form M-1 with respect to gates and regions defined on Figures 9 and 30 respectively.

Verified: YES

Professional Team Comments:

Clarified the logarithmic dependence of Vmax on pressure difference.

Discussed that no conversion factor is used since the model directly simulates surface winds.

Reviewed recent journal articles published by modeler personnel and collaborators. Discussed in detail the implementation of these methodologies in the current model.

Confirmed that the over water intensity model is based on Hall and Jewson (2007).

Discussed that far-field pressure is now dependent on month and location.

The four wind profile parameters were identified and methods for their calculation were discussed.

Confirmed one-minute 10-meter over-water windspeed is used to define intensity at landfall and for by-passing hurricanes.

Discussed that all historical storm tracks with complete records (such as for central pressure) in HURDAT are used.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

A. Modeled probability distributions of hurricane parameters and characteristics shall be consistent with historical hurricanes in the Atlantic basin.

B. Modeled hurricane landfall strike probabilities shall reflect the Base Hurricane Storm Set used for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).

C. Models shall use maximum one-minute sustained 10-meter windspeed when defining hurricane landfall intensity. This applies both to the Base Hurricane Storm Set used to develop landfall strike probabilities as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter windspeed shall be within the range of windspeeds (in statute miles per hour) categorized by the Saffir-Simpson Scale.

Saffir-Simpson Hurricane Scale:

Category	Winds (mph)	Damage
1	74 – 95	Minimal
2	96 – 110	Moderate
3	111 – 130	Extensive
4	131 – 155	Extreme
5	Over 155	Catastrophic

Audit

1. Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.

2. Describe and support the method of selecting stochastic storm tracks.

3. Describe and support the method of selecting storm track strike intervals. If strike locations are on a discrete set, show the landfall points for major metropolitan areas in Florida.

4. Provide any modeling organization specific research performed to develop the functions used for simulating model variables or to develop databases.

5. Form S-3 will be reviewed for the probability distributions and data sources.

Pre-Visit Letter

20. M-3.A, page 114: Provide a comparison between observed and modeled forward speed distributions for landfalls in region C not provided in Figure 12.

21. M-3.A, page 115: Provide historical hurricane tracks on a map used to develop the histogram for NE Florida landfall.

22. M-3, Disclosure 1, page 116: Provide a summary list of all assumptions used in creating the hurricane characteristics databases.

Verified: YES

Professional Team Comments:

Discussed the datasets used to develop the new fitted distributions for Vmax, Rmax, etc. and clarified the time periods used compared to the data in Form S-3.

Discussed the new cost function optimization approach to selecting stochastic storm tracks.

Discussed that the modeler's landfall gates remain unchanged from the previous submission.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

A. Windfields generated by the model shall be consistent with observed historical storms affecting Florida.

B. The translation of land use and land cover or other source information into a surface roughness distribution shall be consistent with current state-of-the-science and shall be implemented with appropriate geographic information system data.

C. With respect to multi-story structures, the model windfield shall account for the effects of the vertical variation of winds if not accounted for in the vulnerability functions.

Audit

1. Provide any modeling organization-specific research performed to develop the windfield functions used in the model. Identify the databases used.

2. Provide any modeling organization-specific research performed to derive the roughness distributions for Florida and adjacent states.

3. The spatial distribution of surface roughness used in the model will be reviewed.

4. Identify other variables in the model that affect over-land surface windspeed estimation.

5. Provide detailed comparisons of the model windfield with Hurricane Charley (2004), Hurricane Katrina (2005), and Hurricane Wilma (2005).

6. For windfield and/or pressure distributions not previously reviewed, present time-based contour animations (capable of being paused) to demonstrate scientifically reasonable windfield characteristics.

7. The effects of vertical variation of winds as used in the model where applicable will be reviewed. (Trade Secret List item)

8. Form M-2 will be reviewed.

Pre-Visit Letter

23. M-4.A, page 117: Be prepared to provide modeled and observed data for historical storms used in model validation.

24. M-4, Disclosure 1, page 117: Provide an explanation for Figure 13 showing a Vmax of less than 100 mph while 110 mph is given here.

25. M-4, Disclosure 2, page 118: Be prepared to provide additional comparisons of the new wind profile against the Holland profile.

26. M-4, Disclosure 3, page 120: Be prepared to discuss the relationship between the RMS directly simulated surface winds and the flight-level wind profiles derived by Willoughby et al. (2006).

27. M-4, Disclosure 3, page 121: Be prepared to provide HWIND snapshots used to construct the HWIND composites in Figures 15 and 16.

28. M-4, Disclosure 9, page 123: Explain the details and justification for using the stochastic model which is based on historical storms to develop missing parameters for generation of historical footprints.

30. Form M-2, pages 143-148: Define "undefined" in Figures 31-36 and provide why it is needed and values have not been provided by the model for these "undefined" regions.

Verified: YES

Professional Team Comments:

Reviewed windfield reconstructions for the Lake Okeechobee Hurricane (1928) and Hurricanes Charley and Ivan (2004). Discussed availability of windfield data and its spatial coverage for evaluating the windfield.

Reviewed presentation on the method used for adjusting observed winds to correct for height and averaging time for comparison with modeled windfields. Discussed compilation of windspeed return period thresholds by location. Reviewed comparisons of stochastic and historical hazard return periods for Franklin, Monroe, Manatee, and Highlands Counties.

Reviewed comparison of radial variation of hurricane winds for the Holland profile (previous submission) and the new wind profile for three historical storms.

Discussed in detail modeling organization-specific research performed to develop the windfield functions used in the model. Discussed the research underlying the choice of adjustment term included in the Willoughby et al. (2006) profile used in the model.

Modeled windfield footprints for Hurricanes Charley (2004), Katrina (2005) and Wilma (2005) were reviewed and compared to time series of observations.

Contour animations of the modeled windfield for Hurricane Wilma (2005) were reviewed, including the transition of winds from over water to over land.

Discussed that the effects of vertical variation of winds as used in the model is treated in the implementation of the vulnerability functions.

Form M-2 was reviewed and compared with the previous submission.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

A. The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records and with current state-of-the-science.

B. The transition of winds from over-water to over-land within the model shall be consistent with current state-of-the-science.

Audit

1. Describe the variation in over-land decay rates used in the model.

2. Comparisons of the model's weakening rates to weakening rates for historical Florida hurricanes will be reviewed.

3. Transition of winds from over-water to over-land (i.e., landfall) will be reviewed. Provide color-coded snapshot maps of roughness length and spatial distribution of windspeeds over-land and over-water for Hurricane Dennis (2005) and Hurricane Andrew (1992) at the closest time after landfall. (Trade Secret List item)

Pre-Visit Letter

29. M-5, Disclosure 1, page 128: Be prepared to explain how the Collette et al. (2010) use of a modified Rankin vortex affects the simulation of winds over land for hurricane windfields based on the Willoughby et al. (2006) profile.

Verified: YES

Professional Team Comments:

Reviewed modeler research (Colette et al. 2010) for the development of the new over-land filling methodology used in the model. Discussed its implementation, including alternative model testing and determination of appropriate fitting parameters and variables. Reviewed the code used to develop these fits.

Reviewed a flow chart documenting the methodology for developing a complete storm track from genesis to decay, including the track and over-land weakening components.

Discussed in detail the implementation of the over-land filling methodology. Reviewed the code for this implementation.

Reviewed maps of roughness length and spatial distribution of windspeeds over-land and over-water for pure easterly winds and for an example historical storm case.

Reviewed a detailed presentation on the calculation of local roughness and gust coefficients and their translation to a site coefficient for the determination of damaging winds used in the model.

Reviewed the range of magnitudes for gust factors spanning all land use classes in the model.

M-6 Logical Relationships of Hurricane Characteristics

A. The magnitude of asymmetry shall increase as the translation speed increases, all other factors held constant.

B. The mean windspeed shall decrease with increasing surface roughness (friction), all other factors held constant.

Audit

1. Form M-3 and the modeling organization's sensitivity analyses provide the information used in auditing this standard.

2. Justify the relationship between central pressure and radius of maximum winds.

3. Justify the variation of the asymmetry with the translation speed.

Verified: YES

Professional Team Comments:

Discussed the updates to Rmax, pmin and Vmax fits based on expanded historical datasets used.

Reviewed Form M-3 and discussed the new data justifying the changes in the distributions.

Discussed in detail the method used for incorporating windfield asymmetry and its variation into modeled storms. Reviewed example storms illustrating the change in asymmetry with forward speed of the storm.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision)*

A. Development of the vulnerability functions is to be based on a combination of the following: (1) historical data, (2) tests, (3) structural calculations, (4) expert opinion, or (5) site inspections. Any development of the vulnerability functions based on structural calculations or expert opinion shall be supported by tests, site inspections, and historical data.

B. The method of derivation of the vulnerability functions and associated uncertainties shall be theoretically sound.

C. Building height, construction type, and construction characteristics shall be used in the derivation and application of vulnerability functions.

D. In the derivation and application of vulnerability functions, assumptions concerning building code revisions and building code enforcement shall be justified.

E. Vulnerability functions shall be separately derived for building structures, mobile homes, appurtenant structures, contents, and time element coverages.

F. The minimum windspeed that generates damage shall be reasonable.

G. Vulnerability functions shall include damage due to hurricane hazards such as windspeed and wind pressure, water infiltration, and missile impact. Vulnerability functions shall not include explicit damage due to flood, storm surge, or wave action.

Audit

1. Historical data shall be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. To the extent that historical data are used to develop vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete structural calculations shall be presented so that a variety of different structure types and construction characteristics may be selected for review. The basis for expert opinion and original site inspection reports shall be available for review.

2. Copies of any papers, reports, and studies used in the development of the vulnerability functions shall be available for review. Copies of all public record documents used may be requested for review.

3. Multiple samples of vulnerability functions for building structures, mobile homes, appurtenant structures, contents, and time element coverages shall be available. The magnitude of logical changes among these items for a given windspeed shall be explained and validation materials shall be available.

4. Justify the construction types and characteristics used.

5. Provide validation of the mean vulnerability functions and associated uncertainties.

6. Document and justify all modifications to the vulnerability functions due to building codes and their enforcement. If age of building is used as a surrogate for building code and code enforcement, provide complete supporting information for the number of age groups used as well as the year(s) of construction that separates particular group(s).

7. Provide validation material for the disclosed minimum windspeed. Provide the computer code showing the inclusion of the minimum windspeed at which damage occurs.

8. The effects on building vulnerability from local and regional construction characteristics and building codes will be reviewed.

9. Form V-1 will be reviewed.

Information to be presented to the Professional Team:

- V-1.2, page 157 – Summaries of exposure and loss data sets and their use in the development of vulnerability functions will be available for on-site review by the Professional Team

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Pre-Visit Letter

Be prepared to provide for the Professional Team's review all engineering data (post event surveys, tests, etc.) received since the review by the Professional Team in 2006. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

31. V-1, page 153: Provide reasons for updates and the extent of changes to vulnerability functions relative to the previous submission.

32. V-1, page 153: Provide plots comparing new vulnerability functions with those used in the previous submission for the following building classes: wood frame, one story, single family home for both pre 1995 and post 2002, 1500-2500 square feet and for the three regions of South Florida Coastal, South Florida Inland, and for the rest of the state.

33. V-1, page 153: Provide plots comparing new vulnerability functions with those used in the previous submission for mobile homes with tie-downs post 1995.

34. V-1.B, pages 153-154: In response to the new language in the standard, describe how the uncertainties associated with vulnerability functions were developed. Define the coefficient of variation used.

35. V-1.C, page 154: In response to the new language in the standard, describe how the model accounts for variation of windspeed with height of buildings in the development of vulnerability functions. Provide plots of vulnerability functions and their uncertainty for reinforced residential concrete construction class for the six categories of number of stories as given in Table 16 on page 160.

36. V-1.E, page 154: Describe the relationship of contents vulnerability functions to building classes and occupancy classes. Provide a plot of contents damage curves and their associated uncertainty for reinforced residential concrete construction class for the six categories of number of stories as given in Table 16 on page 160.

37. V-1.E, page 154: Describe the relationship of time element vulnerability functions to building classes and occupancy classes as well as building and contents damage states. Provide a plot of the model's time element vulnerability functions and their associated uncertainty for reinforced concrete construction class for 1, 4-7, and 15+ story buildings.

38. V-1, Disclosure 3, page 159: Be prepared to discuss the "qualitative insights into the impact of mitigation on the overall building performance" gained from "post-storm reconnaissance missions."

39. V-1, Disclosure 5, page 160: Describe the relationship between Table 16 and the 256 building classes for each region.

43. Form V-1, page 169: Account for differences between this year's submission and the previous submission.

Verified: YES

Professional Team Comments:

Discussed changes to the vulnerability model based on new claims data analyzed from Hurricane Wilma (2005), the introduction of coastal vulnerability regions, and the new windfield reconstructions of key historical events.

Discussed the new Hurricane Wilma (2005) claims data received and processed from three companies. RMS stated the additional claims data increased the modeled-to-incurred ratios for historical events and was more pronounced for buildings along the coast. As a result of the reanalysis of claims data, coastal vulnerability regions were introduced raising inland vulnerability and lowering coastal vulnerability relative to the previous vulnerability model.

Reviewed graphical comparison of mean damage ratio for pre-1995 masonry claims data from the inland region in south Florida with the new and old vulnerability curves.

Reviewed scatter plots of ZIP Code aggregated modeled-to-incurred loss comparisons for single-family dwellings in North/Central Florida inland and coastal, and South Florida inland and coastal using loss data from Hurricanes Andrew (1992), Charley (2004), Frances (2004), Jeanne (2004), and Wilma (2005).

Reviewed the new vulnerability regions added for Florida. Discussed the external vulnerability review by Tom Smith of TLSmith Consulting.

Reviewed the new single family dwelling floor area bands based on new claims data received. The existing floor-area bands were redefined and one additional large floor-area band for greater than 10,000 square feet was added.

Reviewed graphical trend of decreasing vulnerability with increasing floor-area for one-story masonry structures.

Reviewed summary of modeled-to-incurred comparisons between the previously accepted model version and the current model version using 2004/2005 claims data.

Reviewed client 2005 claims data summary and correspondence with company responding to questions.

Reviewed inventory distribution by floor-area categories.

Reviewed the methodology and assumptions used for developing the industry exposure database.

Discussed the development of the commercial residential vulnerability functions and the developmental differences from the personal residential vulnerability functions.

Reviewed comparisons between the previously accepted model version and the current model version single family wood frame 1-story vulnerability functions for South Florida Inland pre-1995 and post 2001, South Florida Coastal pre-1995 and post 2001, and mobile home with tie-downs post 1995.

Discussed the uncertainties associated with the vulnerability functions derived from claims data.

Discussed the variation of windspeed over the height of a building is not modeled explicitly. The loads on buildings of different heights are accounted for in the implementation of the different height bands.

Discussed that the model does not differentiate between condo units on various floors.

Reviewed plots of the new vulnerability functions, contents vulnerability functions, and time element vulnerability functions and their associated uncertainties for a reinforced residential concrete structure for 1 story, 4-7 stories, and 15+ stories.

Discussed the relationship of contents vulnerability functions to building classes and occupancy classes.

Reviewed validation statistics and plot of contents damages for Hurricanes Andrew (1992), Charley (2004), Frances (2004), Jeanne (2004), and Wilma (2005).

Reviewed field notes and results from field survey studies after Hurricane Charley (2004) and Hurricane Katrina (2005).

Discussed no direct impact from field survey studies on model.

Reviewed plot of roof cover vulnerability from field surveys after Hurricane Charley (2004) and Hurricane Katrina (2005).

Discussed the 256 residential building classes implemented in the current model version summarized in an Excel spreadsheet. Discussed the increase in number of classes being due to new floor area categories and occupancy classes.

Reviewed primary damage curves and Form V-1 reference structure curves comparisons between the previous submission and the current model version. Discussed the changes in the reference structure curves.

Discussed the differences between Form V-1 in the current and previous submissions.

Reviewed the methodology for developing commercial residential and condo owners vulnerability functions. Discussed the relationship between the home owners association (HOA) vulnerability functions and the condo owners vulnerability functions.

Reviewed comparison of 15-story concrete office building vulnerability curves.

Discussed procedure used to develop uncertainties on vulnerability functions from claims data.

V-2 Mitigation Measures

A. Modeling of mitigation measures to improve a structure's wind resistance and the corresponding effects on vulnerability shall be theoretically sound. These measures shall include fixtures or construction techniques that enhance:

- ***Roof strength***
- ***Roof covering performance***
- ***Roof-to-wall strength***
- ***Wall-to-floor-to-foundation strength***
- ***Opening protection***
- ***Window, door, and skylight strength.***

B. Application of mitigation measures shall be empirically justified both individually and in combination.

Audit

1. Forms V-2 and V-3 (Trade Secret List item) provide the information used in auditing this Standard.

2. Individual mitigation measures as well as their effect on damage due to use of multiple mitigation measures will be reviewed. Any variation in the change over the range of windspeeds for individual and multiple mitigation measures will be reviewed.

3. Mitigation measures used by the model that are not listed as required in this Standard will be disclosed and shown to be theoretically sound and reasonable.

Pre-Visit Letter

Provide five (5) printed copies of Form V-3 and the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete.

40. V-2.A, page 162: Justify a default of no secondary modifiers if none are specifically selected by the user.

41. V-2.B, page 162: Describe how mitigation measures impact the coefficient of variation of damage ratio.

42. V-2, Disclosure 1, page 162: Describe the changes made in completing Form V-2 for this submission relative to the previous submission.

44. Form V-2, page 172: Be prepared to discuss Form V-2 results in comparison to the previous submission (for example, 3.9% and 6.1% for 160 mph where all the individual entries are 0%).

Verified: YES

Professional Team Comments:

Reviewed changes to the secondary modifier options used to reflect mitigation measures. Eight modifiers were combined into four, two modifiers were retired, and one modifier was added.

The two modifiers roof framing type and mechanical/electric equipment side of building were retired due to being embedded in the primary vulnerability functions or due to their seldom use.

The modifiers combined were roof age and maintenance combined to roof age/condition; roof geometry and parapets combined to roof geometry; wind resistance windows and doors combined to opening protection; and cladding type and wind missiles combined to cladding type. Discussed the combining of the modifiers to capture combination cases that play a crucial role, to avoid combinations that are not realistic, and to improve quantifiability based on damage investigations from Hurricane Wilma (2005) and to be consistent with the OIR-B1-1802 form.

The new modifier added addresses flashing and coping quality.

Reviewed the secondary modifier options available in RiskLink 11.0 for opening protection, roof covering, roof geometry (including roof parapets), roof anchor, roof sheathing attachment, and construction quality.

Reviewed that options for residential appurtenant structures were revised as inspired by field experience from 2004 and 2005 hurricanes.

Reviewed revision to the frame-foundation connection modifier options.

Reviewed revisions to the secondary modifiers for roof covering, built-up roof; roof covering, concrete/clay tiles; roof covering, metal sheathing; roof anchor toe nailing, and 6d nailing attachment options.

Reviewed documentation from roof quality workshop, The Roof Construction Quality Project Meeting, April 15-16, 2010.

Reviewed plot of Form V-2 windspeeds and effect of capping at the high end that results in no impact for individual mitigation measures until the features are combined in the fully mitigated structure.

Reviewed Form V-3 and confirmed consistency with the submitted Form V-2.

Discussed the default of no secondary modifiers if none are specifically selected by the user in order to obtain an unbiased loss estimate.

Discussed how specifying multiple mitigation measures causes the coefficient of variation of the damage ratio to decrease.

Reviewed plot comparing Form V-2 reference structure and mitigated structure damage functions with corresponding function for average structure.

Reviewed the changes in completing the current submission Form V-2 from the previous submission and the differences in the results for membrane roof cover, door and skylight cover, laminated glass, wall foundation strength, and roof sheathing attachment mitigation measures.

Discussed method for ensuring appropriate upper limit for combinations of modifiers.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeled Loss Costs and Probable Maximum Loss Levels*

*(*Significant Revision)*

Modeled loss costs and probable maximum loss levels shall reflect all insured wind related damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater on land in Florida.

Audit

1. The model will be reviewed to determine that the definition of an event in the model is consistent with Standard A-1

2. The model will be reviewed to determine that by-passing storms and their effects are considered in a manner that is consistent with Standard A-1.

3. The model will be reviewed to determine whether (if so, how) the model takes into account flood or hurricane storm surge.

Verified: YES

Professional Team Comments:

Discussed modeled loss costs and probable maximum loss levels reflecting damage from storms making landfall as a hurricane and by-passing storms that generate damaging winds at the coast.

A-2 Underwriting Assumptions*

*(*Significant Revision)*

A. When used in the modeling process or for verification purposes, adjustments, edits, inclusions, or deletions to insurance company input data used by the modeling organization shall be based upon accepted actuarial, underwriting, and statistical procedures.

B. For loss cost and probable maximum loss level estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) claim payment practices, (4) coinsurance, (5) contractual provisions, and (6) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be appropriate.

Audit

1. Demonstrate how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify model calculations. For example, the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.

2. Provide the percentage of loss at or above which the model assumes a total loss.

Pre-Visit Letter

Be prepared to provide for the Professional Team's review, all insurance company claims data received since 2004, including all data related to the 2004 and 2005 hurricane seasons. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Verified: YES

Professional Team Comments:

Reviewed the loss normalization methodology and the exposure normalization factors for trending losses.

Reviewed client 2005 claims data summary and correspondence with company responding to questions.

Discussed the claim practices of insurers as they relate to the model. Discussed the impact of public adjusters on claims paid and the effects of contractual obligations on commercial residential model calculations.

A-3 Loss Cost Projections and Probable Maximum Loss Levels*

*(*Significant Revision)*

A. Loss cost projections and probable maximum loss levels shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

B. Loss cost projections and probable maximum loss levels shall not make a prospective provision for economic inflation.

C. Loss cost projections and probable maximum loss levels shall not include any provision for direct hurricane storm surge losses.

D. Loss cost projections and probable maximum loss levels shall be capable of being calculated at a geocode (latitude-longitude) level of resolution.

Audit

1. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, and economic inflation.

Verified: YES

Professional Team Comments:

Verified that modeled loss costs do not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin. Verified that the model does not make a prospective provision for economic inflation.

A-4 Demand Surge*

*(*Significant Revision)*

A. Demand surge shall be included in the model's calculation of loss costs and probable maximum loss levels using relevant data.

B. The methods, data, and assumptions used in the estimation of demand surge shall be actuarially sound.

Audit

1. Provide the data and methods used to incorporate individual aspects of demand surge on personal and commercial residential coverages, inclusive of the effects from building material costs, labor costs, contents costs, repair time, etc.

2. All referenced literature will be reviewed to determine applicability.

Pre-Visit Letter

45. A-4, Disclosure 1, page 179: Provide estimates of the percentage of total losses that fall into each of the three categories if Hurricane Andrew (1992) were to occur in 2010.

Verified: YES

Professional Team Comments:

Reviewed changes to part of the Post Event Loss Amplification model (Demand Surge). Methodology was updated with new economic data accounting for changes in Gross Domestic Product, the current state of the economy and influence of out of state workforce for significant events.

Discussed reason for the reduction in demand surge in the financial model that is due to model increases in other components. Overall loss costs increase due to other model changes resulting in an increase in the effect of demand surge.

Reviewed percentage of total losses by loss amount, economic demand surge, claims inflation, and SuperCat if Hurricane Andrew (1992) were to occur in 2010.

A-5 User Inputs

All modifications, adjustments, assumptions, inputs and/or input file identification, and defaults necessary to use the model shall be actuarially sound and shall be included with the model output report. Treatment of missing values for user inputs required to run the model shall be actuarially sound and described with the model output report.

Audit

1. Quality assurance procedures shall include methods to assure accuracy of insurance data. Compliance with this standard will be readily demonstrated through documented rules and procedures.

2. All model inputs and assumptions will be reviewed to determine that the model output report appropriately discloses all modifications, adjustments, assumptions, and defaults used to produce the loss costs.

Pre-Visit Letter

46. A-5, Disclosure 2, page 181: Clarify where to find in the model output report the option selected in the user interface to run either the near term model or the Florida only long term model.

Verified: YES

Professional Team Comments:

Reviewed revised Appendix D, Analysis Summary Report for FCHLPM indicating the options selected by users. Reviewed the various options available for users to select.

A-6 Logical Relationship to Risk*

*(*Significant Revision)*

A. Loss costs shall not exhibit an illogical relation to risk, nor shall loss costs exhibit a significant change when the underlying risk does not change significantly.

B. Loss costs produced by the model shall be positive and non-zero for all valid Florida ZIP Codes.

C. Loss costs cannot increase as the quality of construction type, materials and workmanship increases, all other factors held constant.

D. Loss costs cannot increase as the presence of fixtures or construction techniques designed for hazard mitigation increases, all other factors held constant.

E. Loss costs cannot increase as the quality of building codes and enforcement increases, all other factors held constant.

F. Loss costs shall decrease as deductibles increase, all other factors held constant.

G. The relationship of loss costs for individual coverages, (e.g., structures and appurtenant structures, contents, and time element) shall be consistent with the coverages provided.

Audit

1. Graphical representations of loss costs by ZIP Code and county will be reviewed.

2. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.

3. The procedures used by the modeling organization to verify the individual loss cost relationships will be reviewed. Forms A-1, A-2, A-3, A-4, and A-5 will be used to assess coverage relationships.

Verified: YES

Professional Team Comments:

Reviewed results provided in Forms A-3. Discussed underlying reasons for decrease in sum of losses for Hurricanes Jeanne and Frances (2004) from the previous submission.

A-7 Deductibles, Policy Limits, and Coinsurance*

*(*Significant Revision)*

A. The methods used in the development of mathematical distributions to reflect the effects of deductibles, policy limits, and coinsurance shall be actuarially sound.

B. The relationship among the modeled deductible loss costs shall be reasonable.

C. Deductible loss costs shall be calculated in accordance with s. 627.701(5)(a), F.S.

D. The effects of coinsurance on commercial residential loss costs produced by the model shall be actuarially sound.

Audit

1. Describe the process used to determine the accuracy of the insurance-to-value criteria in data used to develop or validate the model results.

1. To the extent that historical data are used to develop mathematical depictions of deductibles, policy limit, and coinsurance functions, demonstrate the goodness-of-fit of the data to fitted models.

2. Justify changes from the previously accepted submission in the relativities among corresponding deductible amounts for the same coverage.

Verified: YES

Professional Team Comments:

Reviewed change to ensure that the model assumes a 2% deductible for personal residential risks when the user does not supply a deductible.

Reviewed modifications to the financial model to improve the handling of policies that include multiple limits and deductible amounts.

Reviewed methodology for deductible, policy limit, and coinsurance calculations.

Reviewed implementation of coinsurance in the source code.

A-8 Contents*

*(*Significant Revision)*

A. The methods used in the development of contents loss costs shall be actuarially sound.

B. The relationship between the modeled structure and contents loss costs shall be reasonable, based on the relationship between historical structure and contents losses.

Audit

1. To the extent that historical data are used to develop mathematical depictions of contents functions, demonstrate the goodness-of-fit of the data to fitted models.

2. Justify changes from the previously accepted submission in the relativities between loss costs for structures and the corresponding loss costs for contents.

Pre-Visit Letter

47. A-8, Disclosure 1, page 191: Provide a detailed description of what is being provided on Figure 44. Prepare a plot which super imposes the corresponding contents damage curve on Figure 44.

Verified: YES

Professional Team Comments:

Reviewed validation statistics and plot of contents damages for Hurricanes Andrew (1992), Charley (2004), Frances (2004), Jeanne (2004), and Wilma (2005).

Discussed the relationship between contents and building vulnerability functions for condo owner occupancies.

A-9 Time Element Coverage*

*(*Significant Revision)*

A. The methods used in the development of time element coverage loss costs shall be actuarially sound.

B. Time element loss cost derivations shall consider the estimated time required to repair or replace the property.

C. The relationship between the modeled structure and time element loss costs shall be reasonable, based on the relationship between historical structure and time element losses.

D. Time element loss costs produced by the model shall appropriately consider time element claims arising from indirect loss.

Audit

1. Documentation and justification of the following will be reviewed:
   a. The method of derivation and data on which the time element vulnerability functions are based;
   b. Validation data specifically applicable to time element coverages;
   c. Assumptions regarding the coding of time element losses by insurers;
   d. The effects of demand surge on time element for Hurricane Andrew (1992) and the 2004 and 2005 hurricane seasons;
   e. Assumptions regarding the variability of time element losses by size of property;
   f. Statewide application of time element coverage assumptions;
   g. Assumptions regarding time element coverage for mobile homes, tenants, and condo unit owners exposure;
   h. The methods used to incorporate the estimated time required to repair or replace the property;
   i. The methodology and available validation for determining the extent of infrastructure damage and its effect on time element costs.
2. To the extent that historical data are used to develop mathematical depictions of time element functions, demonstrate the goodness-of-fit of the data to fitted models.

Pre-Visit Letter

48. A-9, Disclosure 2, page 194: Provide a detailed description of what is being provided on Figure 45. Prepare a plot which super imposes the corresponding time element damage curve on Figure 45.

Verified: YES

Professional Team Comments:

Reviewed plot of claims validation to the time element vulnerability function.

A-10 Output Ranges*

*(*Significant Revision)*

A. Output ranges shall be logical and any deviations supported.

B. All other factors held constant, output ranges produced by the model shall reflect lower loss costs for:

1. masonry construction versus frame construction,

2. personal residential risk exposure versus mobile home risk exposure,

3. in general, inland counties versus coastal counties, and

4. in general, northern counties versus southern counties.

Audit

1. Forms A-6, A-7, and A-8 will be reviewed. The sample output range report produced by the model for commercial residential loss costs will be reviewed.

2. Justify all changes from the previously accepted submission using the 2007 Florida Hurricane Catastrophe Fund aggregate personal residential exposure data.

3. Output ranges will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.

4. Anomalies in the output range data will be reviewed and shall be justified.

Pre-Visit Letter

Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2007 FHCF exposure data.

49. Form A-7, page 322: Be prepared to provide a detailed description of the changes in the output ranges from those in the previous submission, with particular attention to the following areas:
    a. Zero Deductible Frame, Masonry, and Mobile Home structure loss costs
    b. Appurtenant Structures – all rows
    c. Inland Masonry loss costs – all columns
    d. All Frame Renters loss costs

Verified: YES

Professional Team Comments:

Reviewed changes in zero deductible frame, masonry, and mobile home structure loss costs. The increases in the inland and central counties are due to the inland filling and vulnerability updates. The decreases in the north region are due to the updated landfall rates. The interaction between the vulnerability and hazard model changes worked to offset each other out in the south and coastal regions.

Reviewed changes in ALE and frame renters loss costs.

Reviewed the sample output range report for commercial residential loss costs. Discussed the process used for developing and completing the commercial residential output range report.

Reviewed the hazard and vulnerability model changes contribution to the loss costs in Jackson, Gadsden, and Calhoun Counties.

A-11 Probable Maximum Loss*

*(*Significant Revision)*

The methods, data, and assumptions used in the estimation of probable maximum loss levels shall be actuarially sound.

Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-9. (Trade Secret List item)

2. All referenced literature will be reviewed to determine applicability.

Verified: YES

Professional Team Comments:

Verified no change in the methodology for producing probable maximum loss estimates.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

A. The use of historical data in developing the model shall be supported by rigorous methods published in currently accepted scientific literature.

B. Modeled and historical results shall reflect agreement using currently accepted scientific and statistical methods in the appropriate disciplines.

Audit

1. Forms S-1, S-2, and S-3 will be reviewed. Provide justification for the distributions selected including, for example, citations to published literature or analyses of specific historical data.

2. The modeling organization characterization of uncertainty for windspeed, damage estimates, annual loss, and loss costs will be reviewed.

Verified: YES

Professional Team Comments:

Discussed process for completing the plot in Figure 70 showing the uncertainty in loss costs for output ranges.

Reviewed graphical comparison for the inland filling rate and discussed how the bounds were determined.

Reviewed histogram of observed and modeled Amax values and discussed the impact of Amax on the model windfield.

Reviewed ZIP Code scatter plots of modeled to incurred losses for commercial residential buildings and condo owners.

Reviewed all fits reported in the submission.

Reviewed the methodology for the sensitivity analyses depicted in Figures 70 and 71.

S-2 Sensitivity Analysis for Model Output*

*(*Significant Revision due to requirement of Form S-6)*

The modeling organization shall have assessed the sensitivity of temporal and spatial outputs with respect to the simultaneous variation of input variables using currently accepted scientific and statistical methods in the appropriate disciplines and have taken appropriate action.

Audit

1. The modeling organization's sensitivity analysis will be reviewed in detail. Statistical techniques used to perform sensitivity analysis shall be explicitly stated. The results of the sensitivity analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.

2. Form S-6 will be reviewed.

Pre-Visit Letter

50. Form S-6, page 372: Be prepared to explain the results of the printed version of the revised contour plots, the originals including one with no differentiation.

Verified: YES

Professional Team Comments:

Reviewed the results from Form S-6. Loss cost summary results were reproduced by the Professional Team. Windspeed results were reviewed from both a statistical and meteorological perspective.

Discussed the benefits of the sensitivity analyses in directing future projects.

S-3 Uncertainty Analysis for Model Output*

*(*Significant Revision due to requirement of Form S-6)*

The modeling organization shall have performed an uncertainty analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods in the appropriate disciplines and have taken appropriate action. The analysis shall identify and quantify the extent that input variables impact the uncertainty in model output as the input variables are simultaneously varied.

Audit

1. The modeling organization's uncertainty analysis will be reviewed in detail. Statistical techniques used to perform uncertainty analysis shall be explicitly stated. The results of the uncertainty analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.

2. Form S-6 will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the results from Form S-6. Windspeed results were reasonable from both a statistical and meteorological perspective.

Discussed the benefits of the uncertainty analyses in directing future projects.

S-4 County Level Aggregation

At the county level of aggregation, the contribution to the error in loss cost estimates attributable to the sampling process shall be negligible.

Audit

1. Provide a graph assessing the accuracy associated with a low impact area such as Nassau County. We would expect that if the contribution error in an area such as Nassau County is small, the error in the other areas would be small as well. Assess where appropriate, the contribution of simulation uncertainty via confidence intervals.

Verified: YES

Professional Team Comments:

Discussed the sampling plan used for determining average annual loss costs.

Discussed the method for determining the sample size provided in Form S-2.

S-5 Replication of Known Hurricane Losses*

*(*Significant Revision)*

The model shall estimate incurred losses in an unbiased manner on a sufficient body of past hurricane events from more than one company, including the most current data available to the modeling organization. This standard applies separately to personal residential and, to the extent data are available, to commercial residential. Personal residential experience may be used to replicate structure-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail.

Audit

1. The following information for each insurer and hurricane will be reviewed:
   a. The validity of the model assessed by comparing expected losses produced by the model to actual observed losses incurred by insurers at both the state and county level,
   b. The version of the model used to calculate modeled losses for each hurricane provided,
   c. A general description of the data and its source,
   d. A disclosure of any material mismatch of exposure and loss data problems, or other material consideration,
   e. The date of the exposures used for modeling and the date of the hurricane,
   f. An explanation of differences in the actual and modeled hurricane parameters,
   g. A listing of the departures, if any, in the windfield applied to a particular hurricane for the purpose of validation and the windfield used in the model under consideration,
   h. The type of property used in each hurricane to address:
      1. Personal versus commercial
      2. Residential structures
      3. Mobile homes
      4. Commercial residential
      5. Condominiums
      6. Structures only
      7. Contents only,
   i. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses, or the modeled losses.

2. The following documentation will be reviewed:
   a. Publicly available documentation referenced in the submission,
   b. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
   c. An analysis that identifies and explains anomalies observed in the validation data,
   d. User input sheets for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

3. The confidence intervals used to gauge the comparison between historical and modeled losses will be reviewed.

4. Form S-4 will be reviewed.

5. The results of one hurricane event for more than one insurance company and the results from one insurance company for more than one hurricane event will be reviewed to the extent data are available.

Verified: YES

Professional Team Comments:

Reviewed the commercial residential validation comparisons provided in Form S-5 and the underlying commercial residential claims data for Figure 85.

Reviewed the choice of personal residential examples given in Form S-5.

S-6 Comparison of Projected Hurricane Loss Costs

The difference, due to uncertainty, between historical and modeled annual average statewide loss costs shall be reasonable, given the body of data, by established statistical expectations and norms.

Audit

1. Form S-5 will be reviewed for consistency with Standard G-1, Disclosure 5.

2. Justify the following:
   a. Meteorological parameters,
   b. The effect of by-passing hurricanes,
   c. The effect of actual hurricanes that had two landfalls impacting Florida,
   d. The departures, if any, from the windfield, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the model under consideration, and
   e. Exposure assumptions.

Verified: YES

Professional Team Comments:

Reviewed Form S-5.

Discussed results in Form S-5 and Form A-3 for selected historical storms.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

A. The modeling organization shall maintain a primary document binder, containing a complete set of documents specifying the model structure, detailed software description, and functionality. Development of each section shall be indicative of accepted software engineering practices.

B. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the submission shall be consistently documented and dated.

C. The modeling organization shall maintain (1) a table of all changes in the model from the previously accepted submission to the initial submission this year and (2) a table of all substantive changes since this year's initial submission.

D. Documentation shall be created separately from the source code.

Audit

1. The primary document binder, in either electronic or physical form, and its maintenance process will be reviewed. The binder shall contain fully documented sections for each Computer Standard.

2. All documentation shall be easily accessible from a central location.

3. Complete user documentation, including all recent updates, will be reviewed.

4. Modeling organization personnel, or their designated proxies, responsible for each aspect of the software (i.e., user interface, quality assurance, engineering, actuarial, verification) shall be present when the Computer Standards are being audited. Internal users of the software will be interviewed.

5. Provide verification that documentation is created separately from and is maintained consistently with the source code.

6. The tables specified in C-1.C that contain the items listed in Standard G-1, Disclosure 5 will be reviewed. The tables shall contain the item number in the first column. The remaining five columns shall contain specific document or file references for affected components or data relating to the following Computer Standards: C-2, C-3, C-4, C-5, and C-6.

7. Trace the model changes specified in Standard G-1, Disclosure 5 through all Computer Standards.

Information to be presented to the Professional Team:

- C-1.A, page 373 – A Computer Standards primary document binder in electronic form has been prepared by RMS and is available for on-site review by the Professional Team.
- C-1.B, page 373 – Appropriate personnel for software, data preparation and validation, as well as internal users of the software, will be available to the Professional Team when the Computer Standards are being audited.

Pre-Visit Letter

51. C-1.C, page 373: Be prepared to relate the table of contents with the response to Standard G-1, Disclosure 5 by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Discussed the importance of modeler compliance with Standard G-1, Audit Item 2, and the modeler's past and current practices to train all modeler personnel on the scope of Standards C-1 through C-7.

Discussed the communication practices employed by modeler personnel with special emphasis on cross-disciplinary interaction.

Observed that the modeler's inter-group communication with the software development staff could be improved for more effective compliance with Standards C-1 through C-7. Discussed methods devised on-site by the modeler to improve these communications through stricter adherence to the modeler's flowchart-defined product development process.

Reviewed an internal presentation to modeler personnel in 2009 regarding the FCHLPM auditing process, including the wide coverage of the computer standards beyond RiskLink software and data to model development tools, software/model development processes, and the submission process, including forms development.

Reviewed documentation for the current model, RiskLink 11.0.SP1, including all facets of the model specified within Standard G-1, Disclosure 5.

Reviewed documentation for low and high vulnerability functions for sensitivity tests, U.S. & Canada Hurricane Model Methodology.

Verified that all documentation is electronically managed using a central server.

Verified that documentation is created separately from, and maintained consistently with, the source code. Reviewed revised documentation for the over-land filling model and compared with code.

Reviewed the table of all changes from the previous submission.

Reviewed the user input form for exposure modifications and the corresponding revised Analysis Report for FCHLPM with respect to the default vulnerability curves user selection.

C-2 Requirements*

*(*Significant Revision)*

The modeling organization shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component. Requirements shall be updated whenever changes are made to the model.

Audit

1. Provide confirmation that a complete set of requirements for each software component, as well as for each database or data file accessed by a component, has been maintained and documented.

Information to be presented to the Professional Team:

- C-2, page 374 – This documentation, which is described in the response to Disclosure C-2, is available for on-site review by the Professional Team.
- C-2.1, page 374 – Requirements documentation available for on-site review by the Professional Team includes: (list on pages 374-375)

Pre-Visit Letter

52. C-2, page 374: Be prepared to provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed the requirements documentation related to each model change in Standard G-1, Disclosure 5.

Discussed the definitions of functional vs. marketing driven requirements.

C-3 Model Architecture and Component Design

The modeling organization shall maintain and document (1) detailed control and data flow diagrams and interface specifications for each software component, and (2) schema definitions for each database and data file. Documentation shall be to the level of components that make significant contributions to the model output.

Audit

1. The following will be reviewed:
   a. Detailed control and data flow diagrams, completely and sufficiently labeled for each component,
   b. Interface specifications for all components in the model,
   c. Documentation for schemas for all data files, along with field type definitions,
   d. Each network diagram including components, sub-component diagrams, arcs, and labels.

2. A model component custodian, or designated proxy, shall be available for the review of each component.

Information to be presented to the Professional Team:

- C-3, page 376 – This internal model architecture and component design documentation, as well as the developers or modelers responsible for each component, are available for on-site review by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed the flowchart for incorporating the HURDAT database in the calculation of landfall rates.

Reviewed methodology schematic for assigning additional storm parameters to the historical storms in HURDAT.

Reviewed the flowchart for the new site coefficient model.

Reviewed the flowchart of the RMS product development process.

Reviewed the modeler's high-level flowchart of how loss costs are simulated based on key hazard, vulnerability, and financial loss cost modules.

Reviewed the flowchart for constructing the IED (Industry Exposure Database).

Reviewed the hazard model flow chart partitioned into three categories: 1) stochastic module, 2) wind field module, and 3) final event set.

Reviewed several hierarchical flowcharts for the inland filling model.

Reviewed a flowchart defining the fit of model coefficients to WRF inland decay values.

Reviewed the new site gust coefficient flowchart.

Reviewed the modeler's approach for using e-mail groups as a means to coordinate elements of the model architecture and component design.

Reviewed a flowchart defining the process of data handling.

C-4 Implementation

A. The modeling organization shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.

B. The modeling organization shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.

C. All components shall be traceable, through explicit component identification in the flow diagrams, down to the code level.

D. The modeling organization shall maintain a table of all software components affecting loss costs, with the following table columns: (1) Component name, (2) Number of lines of code, minus blank and comment lines; and (3) Number of explanatory comment lines.

E. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.

F. The modeling organization shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Disclosure 5:

1. A list of all equations and formulas used in documentation of the model with definitions of all terms and variables.

2. A cross-referenced list of implementation source code terms and variable names corresponding to items within F.1.

Audit

1. The interfaces and the coupling assumptions will be reviewed.

2. Provide the documented coding guidelines and confirm that these guidelines are uniformly implemented.

3. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.

4. The traceability among components at all levels of representation will be reviewed.

5. The following information shall be available and will be reviewed for each component, either in a header comment block, source control database, or the documentation:
    a. component name,
    b. date created,
    c. dates modified and by whom,
    d. purpose or function of the component, and
    e. input and output parameter definitions.

6. The table of all software components as specified in C-4.D will be reviewed.

7. Model components and the method of mapping to elements in the computer program will be reviewed.

8. Comments within components will be examined for sufficiency, consistency, and explanatory quality.

Information to be presented to the Professional Team:

- C-4.C, page 378 – Detailed data flow diagrams of the model components will be available for review by the Professional Team.

Verified: YES

Professional Team Comments:

Reviewed change to software platform to optimize run-time performance and to provide support for 64-bit operating systems.

Reviewed the windfield code for inland filling and noted that the date modified for this code was correctly captured in the source code management system.

Reviewed the table of software components identifying comment lines in the code.

Discussed the lack of the table required by Standard C-4, Item F. Reviewed a revised table produced during the audit.

Reviewed code for the financial bug identified in the March 14, 2011 modeler letter to the Commission.

Verified that the financial bug fix was also a form of model optimization, and involved skipping the policy coverage calculation when coverage was not defined or when policy coverage detailed output was not selected through the user interface.

Reviewed an incident report associated with the financial bug fix, and its resolution.

Reviewed a bug incident associated with the five additional events, as specified in the March 14, 2011 letter to the Commission.

Reviewed the implementation of handling coinsurance.

Reviewed the mean damage reference spreadsheet calculation of the combined multiplicative effect of handling secondary modifiers.

Reviewed the model implementation for impact of the secondary modifiers.

Reviewed policy gross loss limit calculations.

Reviewed the data format used for storm footprints.

Discussed the modeler's bug/feature request life cycle.

C-5 Verification

A. General

For each component, the modeling organization shall maintain procedures for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. Verification procedures shall include tests performed by modeling organization personnel other than the original component developers.

B. Component Testing

1. The modeling organization shall use testing software to assist in documenting and analyzing all components.

2. Unit tests shall be performed and documented for each component.

3. Regression tests shall be performed and documented on incremental builds.

4. Aggregation tests shall be performed and documented to ensure the correctness of all model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.

C. Data Testing

1. The modeling organization shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.

2. The modeling organization shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.

Audit

1. The components will be reviewed for containment of sufficient logical assertions, exception-handling mechanisms, and flag-triggered output statements to test the correct values for key variables that might be subject to modification.

2. The testing software used by the modeling organization will be reviewed.

3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed including compliance with independence of the verification procedures.

4. Flowcharts defining the processes used for manual and automatic verification will be reviewed.

5. The response to Disclosure 1 will be reviewed.

Pre-Visit Letter

53. C-5, page 381: Be prepared to provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5.

Verified: YES

Professional Team Comments:

Reviewed use of variable value checks ensuring that variables were bounded properly.

Reviewed the unit test for the inland decay model using a cross-check comparison.

Reviewed verification of using plots as a means for unit testing for the revised hazard modeling approach.

Reviewed a test plan designed to test for the financial bug fix specified in the March 14, 2011 letter to the Commission.

C-6 Model Maintenance and Revision

A. The modeling organization shall maintain a clearly written policy for model revision, including verification and validation of revised components, databases, and data files.

B. A revision to any portion of the model that results in a change in any Florida residential hurricane loss cost shall result in a new model version number.

C. The modeling organization shall use tracking software to identify all errors, as well as modifications to code, data, and documentation.

D. The modeling organization shall maintain a list of all model versions since the initial submission for this year. Each model description shall have a unique version identification, and a list of additions, deletions, and changes that define that version.

Audit

1. All policies and procedures used to maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, provide the installation date under configuration control, the current version number, and the date of the most recent change(s).

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed.

4. The list of all model revisions as specified in C-6.D will be reviewed.

Pre-Visit Letter

54. C-6.D, page 386: Be prepared to provide the model version history leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Reviewed RiskLink versioning guidelines. Discussed differences between service pack numbering and minor version numbering.

Reviewed RiskLink and RiskBrowser 11.0 “hand-off” Build Schedule.

Reviewed RiskLink Build 1406 Software Hand-off Notes (11/24/2010) and the process completed.

Reviewed the modeler's approach to identifying the model version given that changes had been made since the last submission as well as fixes to issues identified in the March 14, 2011 letter to the Commission.

Observed inconsistencies in model identifications within the submission, and reviewed a revised approach to model identification created during the audit, resulting in a new model version.

Verified that the model version under review is RiskLink 11.0.SP1.

Reviewed the RMS Product Development process defined as a flowchart.

C-7 Security

The modeling organization shall have implemented and fully documented security procedures for: (1) secure access to individual computers where the software components or data can be created or modified, (2) secure operation of the model by clients, if relevant, to ensure that the correct software operation cannot be compromised, (3) anti-virus software installation for all machines where all components and data are being accessed, and (4) secure access to documentation, software, and data in the event of a catastrophe.

Audit

1. The written policy for all procedures and methods used to ensure the security of code, data, and documentation will be reviewed. Specify all security procedures.

2. Documented security procedures for access, client model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the security documentation, including the revised approach to selection and validation of passwords.

Reviewed the information technology overview detailing new employee orientation procedures related to the Computer Standards.